FINAL REPORT

PHASE I GEOARCHAEOLOGICAL DISTURBANCE STUDY OF THE PROPOSED LOCK HAVEN FLOOD CONTROL CORRIDOR CLINTON COUNTY, PENNSYLVANIA

Prepared by

Vendel Enviro-Industrial Consultants, Inc.
Box 476 Willow Ave.
Knox, Pennsylvania 16232

Submitted to

International Technology Corporation
165 Fieldcrest Avenue
Edison, New Jersey 08818

In

Partial Fulfillment of Contract Number DACW31-85-D-0006
Department of the Army
Baltimore District, Corps of Engineers
Planning Division
P.O. Box 1715
Baltimore, Maryland 21203-1715

15 December 1987

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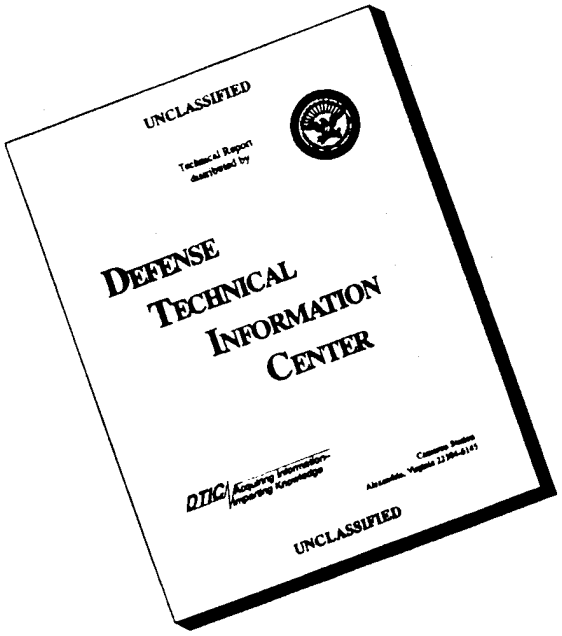

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Frank J. Vento
Frank J. Vento, Ph.D.
President - Co-Director

Philip T. Fitzgibbons
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Foreword and Acknowledgements

The Phase I disturbance study conducted along the proposed Lock Haven Flood Control Project was conducted under the auspices of Vendel Enviro-Industrial Consultants, Inc. (Subcontractor), 1720 Larsen Drive, Pittsburgh, Pennsylvania 15243 via Contract DACW31-85-D-0006 which was administered through International Technology Corporation, 165 Fieldcrest Ave., Edison, New Jersey 08818 by the United States Army Corps of Engineers, Baltimore District, Maryland.

Field work for the disturbance study was inititated on 1 December 1986 and completed on 2 January 1987. This final report presents the results of and makes recommendations based on these field investigations.

Special thanks is given to Robert Yowell, Lock Haven Flood Control Project Director, who helped in identifying the most recent levee alignment corridor and the best access into these areas. All line drawing for this report were drafted and prepared by Mike Sherk. The manuscript was typed by Jacalynn Voight and Tammy Heavan.

F. J. Vento, Ph.D.
President, Vendel Enviro-Industrial Consultants, Inc.

DISTURBANCE STUDY OF THE PROPOSED LOCK HAVEN FLOOD CONTROL PROJECT

Introduction

The purpose of the geologic disturbance study is to identify zones or areas of prior disturbance. Disturbance herein is defined as any natural or man-made disturbance of the soils, sediments and rocks that occur along the proposed flood control project corridor.

Natural disturbances include: 1) erosion of the flood plain by the lateral channel migration of the West Branch and/or its tributary Bald Eagle Creek; 2) flood scouring of the T0 (0 - 10 feet above the normal pool elevation at the Jay Street Bridge) and T1 (10 - 25 feet above the normal pool elevation at the Jay Street Bridge) terraces during bankfull discharge; 3) erosion by surface runoff, primarily during the winter and early spring; 4) mass-wasting along the valley slopes and along the scarp slope of the T1 terrace within the project area and 5) bioturbation of the soils in the study area by naturally occuring plants and animals.

Man made disturbances include: 1) plowing and disking of the T1 terrace surface; 2) municipal, industrial and residential landfills; 3) subsurface utility lines (gas, water, sewage, electric etc.); 4) bridge abutments, tunnels and dams; 5) industrial, municipal and residential structures; 6) highway and road construction (including both paved and unpaved); 7) railroad grades, surface culverts and retaining walls; 8) boat launches and docks (primarily on the lower T0 terrace); 9) wells, cisterns and septic tank fields; and 10) cemeteries.

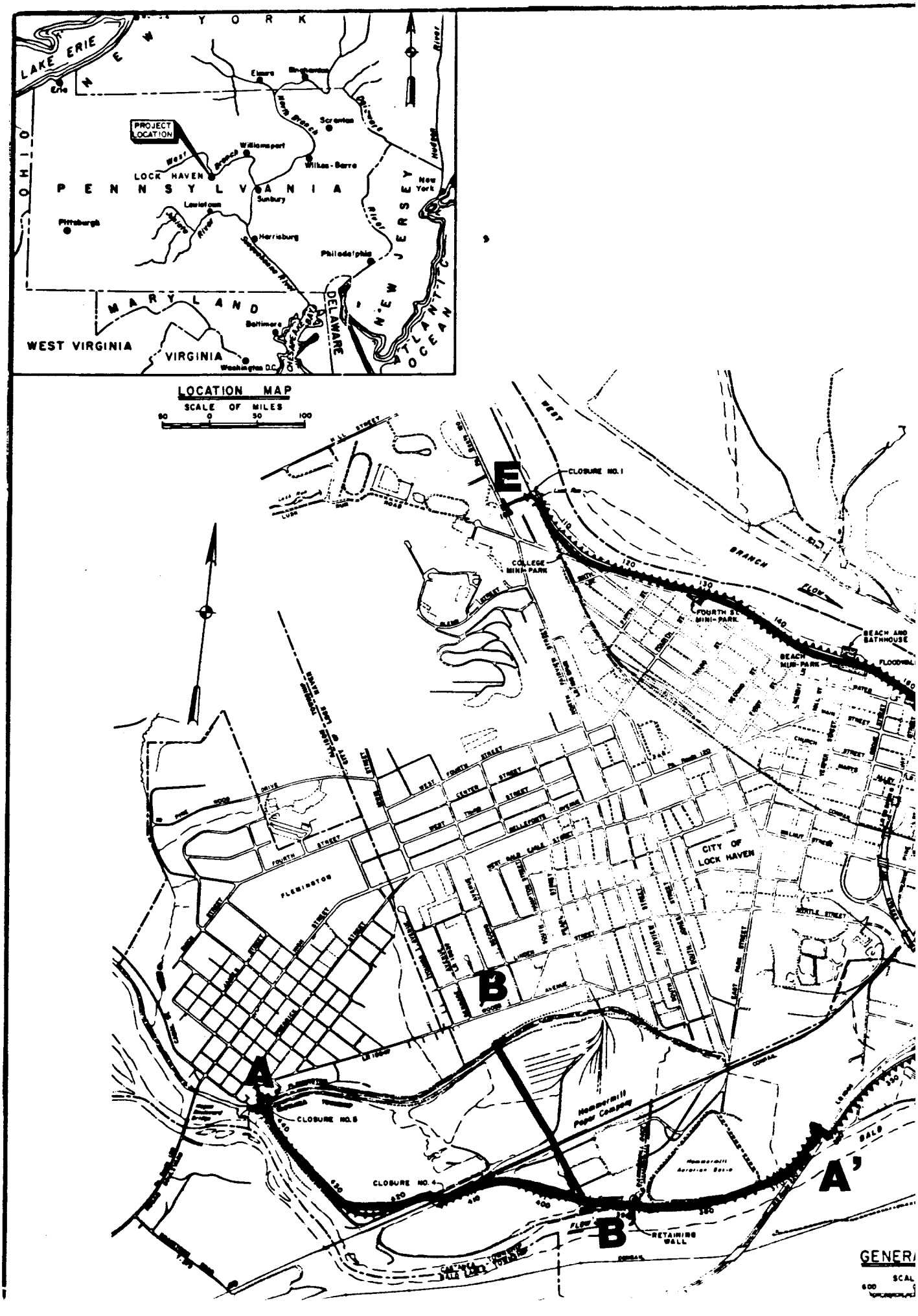
Methodology

The field methods employed during the Phase I disturbance study included: 1) several systematic walk-overs of the entire flood control alignment to identify areas of prior disturbance; 2) discussions with local landowners and city personnel who are knowledgeable about past ground disturbances; 3) core sample logs taken during the preconstruction phase of U.S. Route 220 and core logs taken in 1979-1980 and 1985-1986 for the current flood control project by the Army Corps of Engineers (Figure 1); 4) limited shovel test probes and auger probes completed along previously untested segments of the proposed flood control project corridor and 5) the results of previous investigations conducted by Hay (1986) which identified areas of prior disturbance along selected reaches of the levee/flood wall alignment. The combined data base generated from the use of these methods has allowed for the identification of site specific areas in both Lock Haven and Lower Lockport which have previously received adverse impact by both natural and/or man-made disturbances.

Figures 2 - 7 are geologic cross sections of the proposed levee corridor which depicts the occurrence of areas which contain "fill", undisturbed alluvial sediments and bedrock. These cross sections were prepared from data supplied by the Baltimore District, Army Corps of Engineers.

Physiography

The Lock Haven study area is located within the Ridge and Valley physiographic province. The Ridge and Valley province


NEW YORK
LAKE ERIE
OHIO
PROJECT LOCATION
LOCK HAVEN
West Branch
Susquehanna River
Williamsport
Scranton
Wilkes-Barre
PENNSYLVANIA
Sunbury
Lewistown
Pittsburgh
Juniata River
Harrisburg
Philadelphia
NEW JERSEY
New York
ATLANTIC OCEAN
MARYLAND
Baltimore
DELAWARE
WEST VIRGINIA
VIRGINIA
Washington D.C.
LOCATION MAP
SCALE OF MILES
CLOSURE NO. 1
CLOSURE NO. 5
CLOSURE NO. 4
COLLEGE MINI-PARK
FOURTH ST. MINI-PARK
BEACH AND BATHHOUSE
BEACH MINI-PARK
CITY OF LOCK HAVEN
RETAINING WALL
FLOW
A
A'
B
B'
E

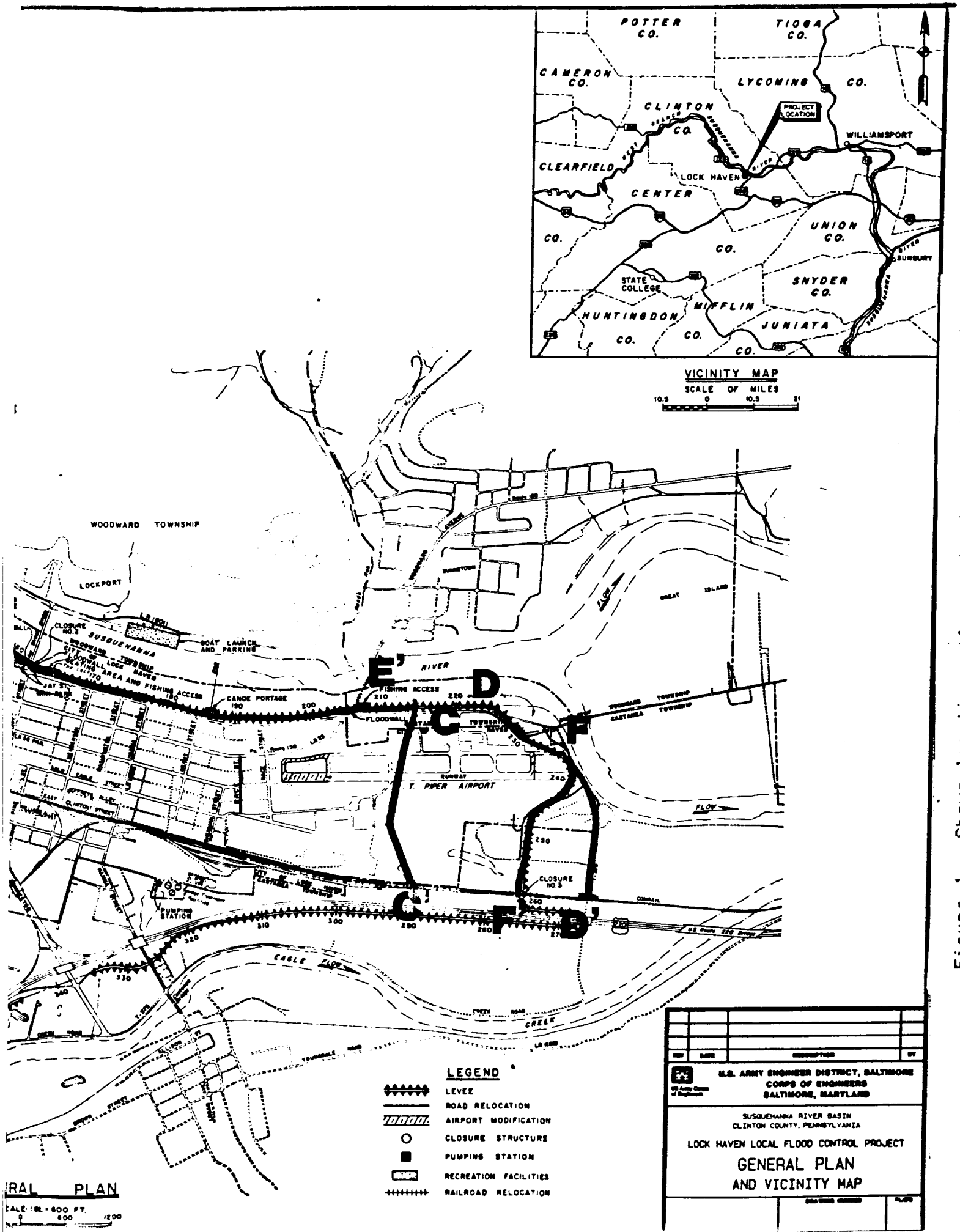
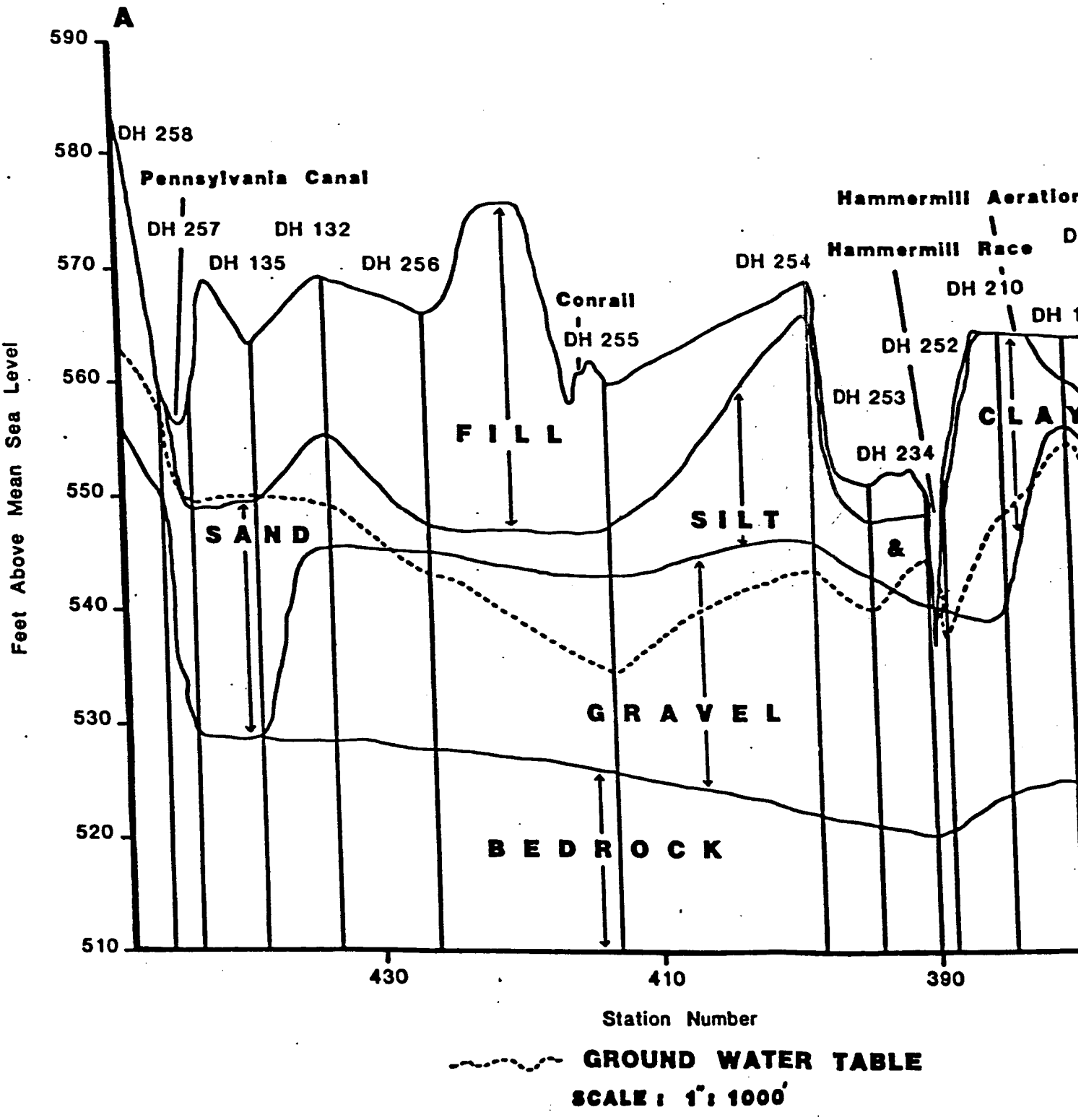


Figure 1. Shows locations of core boring, station numbers and geologic cross sections developed for this


A
590
580
570
560
550
540
530
520
510
Feet Above Mean Sea Level
DH 258
Pennsylvania Canal
DH 257
DH 132
DH 135
DH 256
Conrail
DH 255
DH 254
Hammermill Aeration
Hammermill Race
DH 210
DH 252
DH 253
DH 234
FILL
SAND
SILT
&
GRAVEL
BEDROCK
430
410
390
Station Number
GROUND WATER TABLE
SCALE : 1" : 1000'

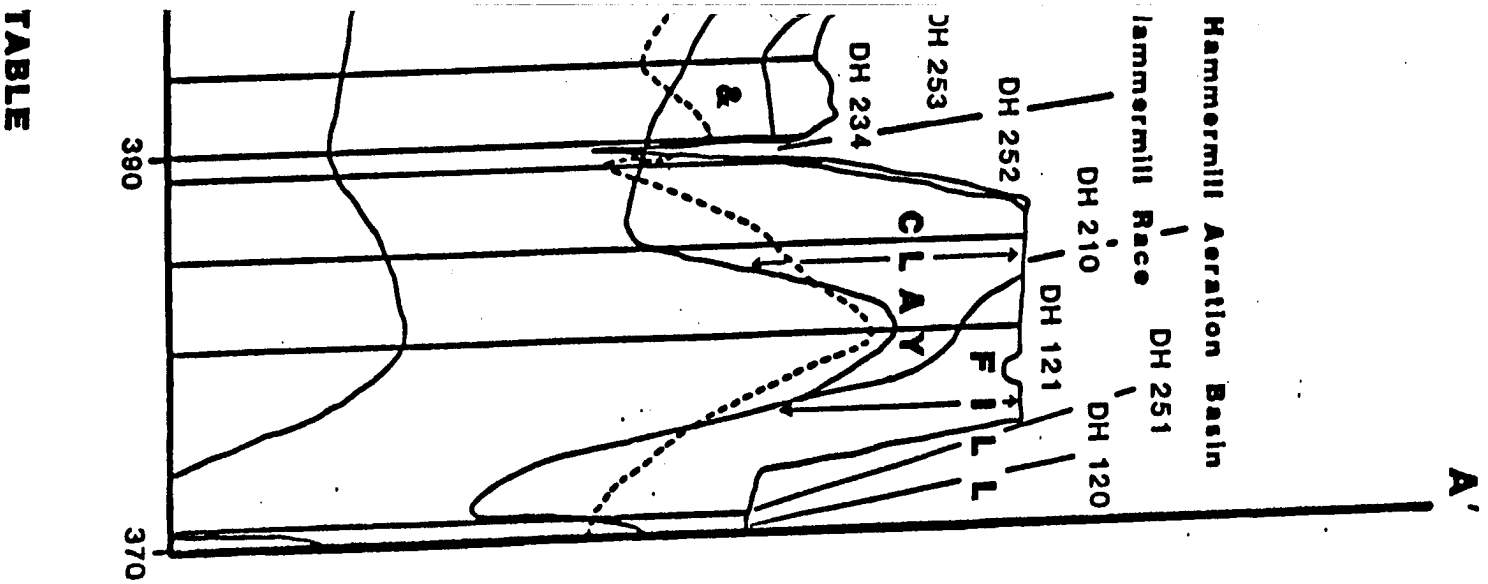


Figure 2. Geologic cross section A - A' (Station 450 to Station 370) along proposed flood control project corridor. Note thick sequences of "fill" along area of corridor which cross-cuts Hammermill property.

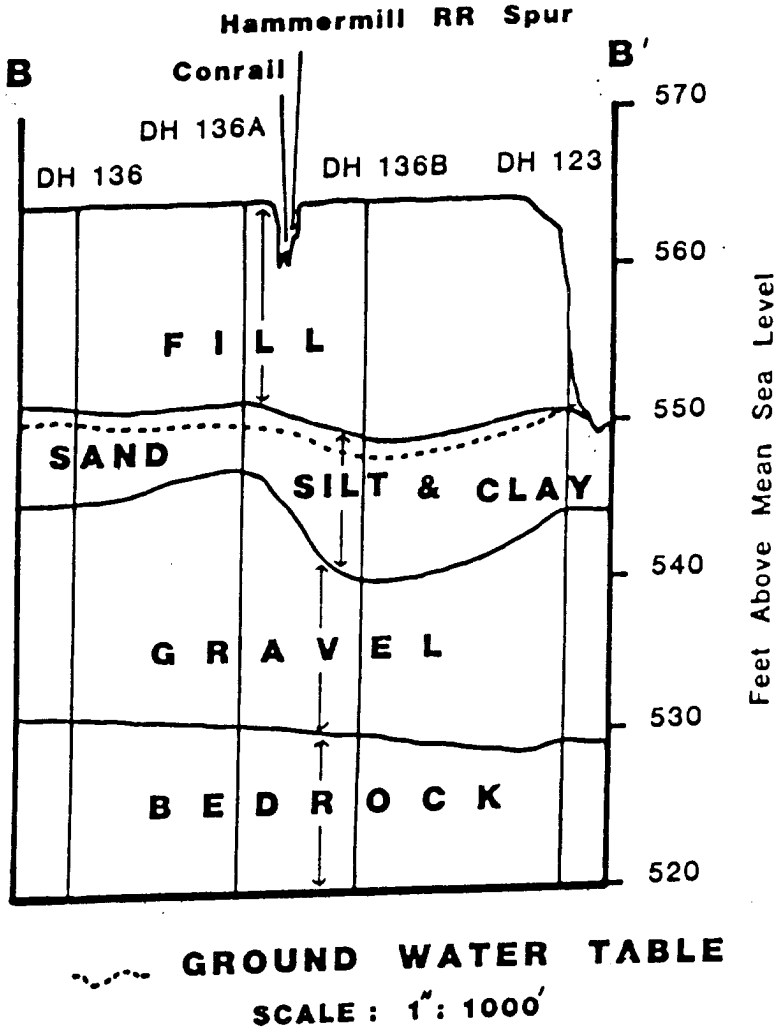


Figure 3. Geologic cross section B - B'. Note thick sequence of "fill" deposits on Hammermill Paper Company lands along line of cross section.

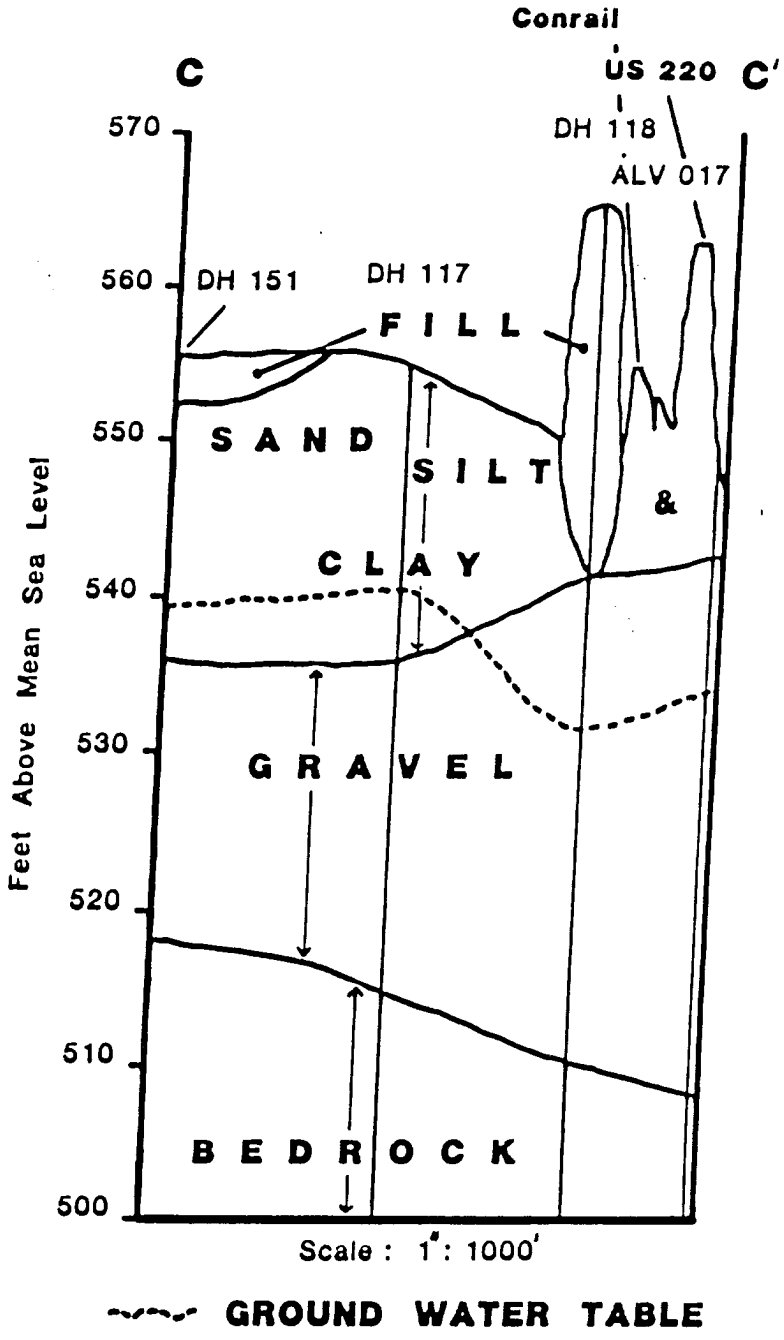


Figure 4. Geologic cross section C - C' across western edge of municipal airport. Note the occurrence of "fill" deposits at the extreme northern and southern portion of cross section.

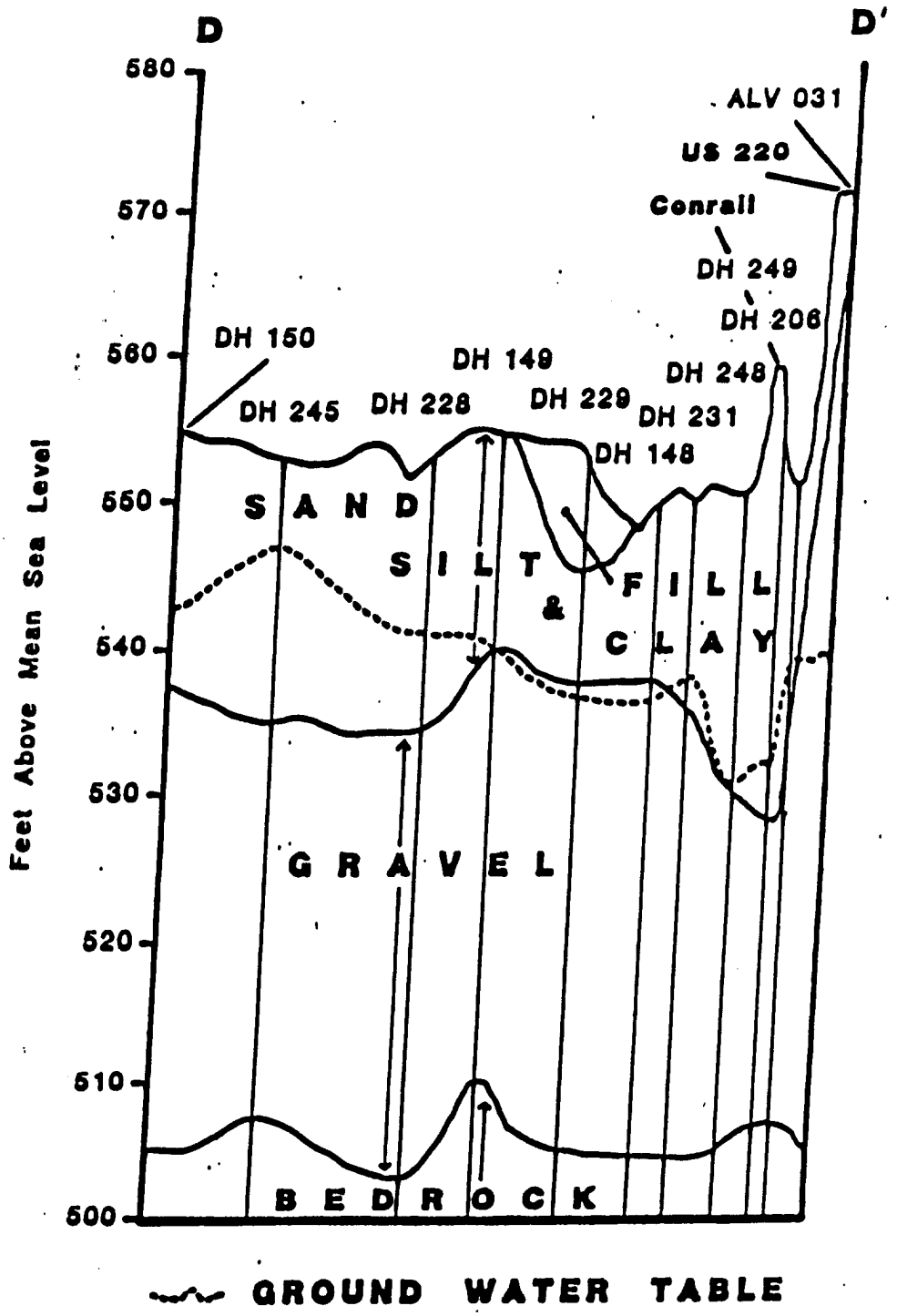
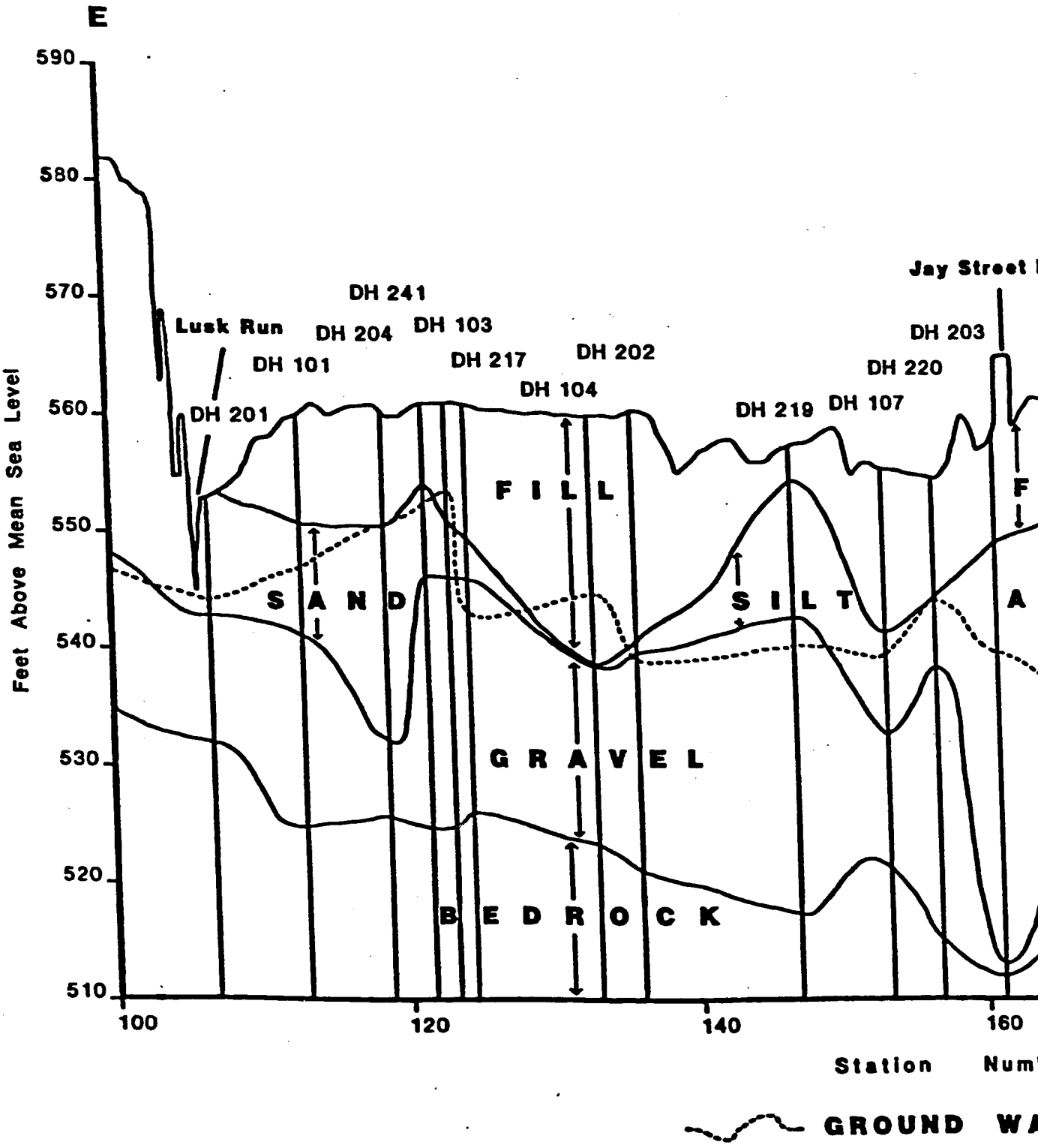


Figure 5. Geologic cross section D - D' (Station 220 to Station 240) across extreme eastern end of municipal airport. Note location of "fill" (old municipal landfill site) deposits.


E
590
580
570
560
550
540
530
520
510
Feet Above Mean Sea Level
Lusk Run
DH 201
DH 101
DH 204
DH 241
DH 103
DH 217
DH 202
DH 104
DH 219
DH 107
DH 220
DH 203
Jay Street
F I L L
S A N D
S I L T
G R A V E L
B E D R O C K
100
120
140
160
Station
GROUND W
SCALE : 1"

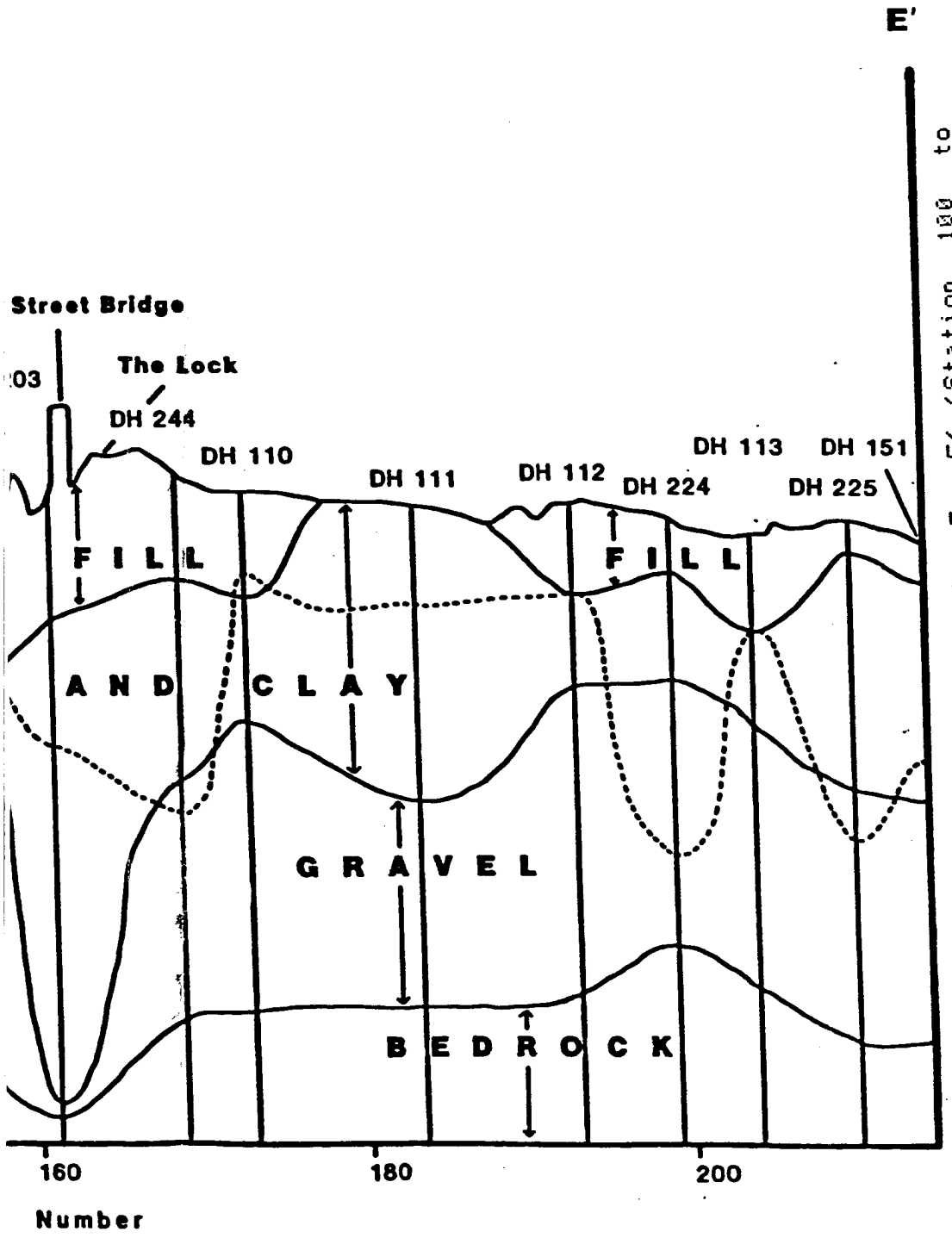


Figure 6. Geologic cross section E - E' (Station 100 to Station 220) along Water Street segment of proposed flood control project. Note areas where "fill" was encountered during coring.

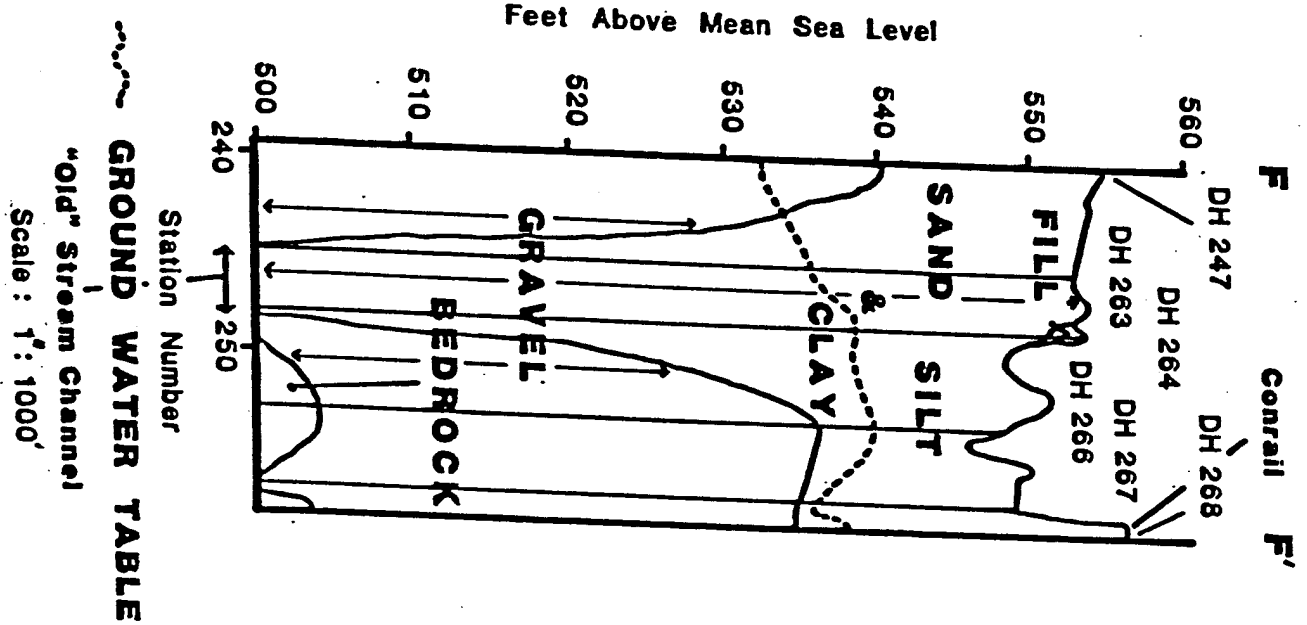


Figure 7. Geologic cross section F - F′ (Station 240 to Station 260) along extreme eastern portion of the proposed flood control project. Note that a relict river channel was encountered during the coring activities. Also note occurrence of "fill" associated with the old American Chemical Company dump site.

extends for a distance of 1200 miles (1920 km), from the St. Lawrence Lowland to Alabama. Its width varies from about 14 miles (22.4 km) at New York-New Jersey state line to 80 miles (128 km) along a line between Harrisburg and Williamsport, Pennsylvania (Thornbury 1965:109).

The Ridge and Valley province exhibits many striking geomorphic features, some of which include: 1) marked parallelism of ridges and valleys due to folding; 2) conspicuous influence of alternating strong and weak strata upon topographic forms; 3) several major transverse streams (Susquehanna River) with notable development of subsequent streams (forming a distinctive trellis drainage pattern); 4) many ridges which display enough accordance (similar height) of summit level to suggest that their crests may represent former erosional surfaces and 5) hundreds of water gaps and wind gaps which indicate frequent past cases of stream diversion and piracy.

The Lock Haven study area proper is located in what is termed the Middle Section (also called the Appalachian Mountain Section) of the Ridge and Valley province. Throughout its length the Middle Section is bounded to the west by the Allegheny Front, a prominent escarpment that forms the eastern edge of the Applachian Plateaus physiographic province. The Allegheny Front lies roughly 2 miles (3.2 km) to the north of the westernmost portion of the proposed Lock Haven Flood Control Project.

The Valley and Ridge province is a result of differential erosion of folded and faulted rock strata. The region consists of alternating resistant and non-resistant sedimentary rocks

which had been laterally compressed during Paleozoic time by plate tectonic forces into a series of anticlinal and synclinal folds. The more resistant sandstones and conglomerates now stand as ridges or mountains, while the less resistant shales and limestones underlie the valleys. The dominant ridge formers in the general study area include the Tuscarora sandstone (Silurian), Oriskany Group (Devonian), Pocono Group (Mississippian) and Pottsville Group (Pennsylvanian). The ridges and valleys trend northeast and commonly display a trellis drainage pattern. Ridges rise to over 2,200 feet (673.2 m) and have a relief from several hundred to 1,600 feet (489.6 km) above the valley bottoms. Some of these mountains, such as Bald Eagle Mountain can be traced over hundreds of miles, interrupted only by water and wind gaps.

General Geology

The bedrock geology in the vicinity of the Lock Haven study area consists of a northeastward-trending belt of Tully limestone (Devonian) which extends from Flemington through Lock Haven to Lockport on the east side of the West Branch of the Susquehanna, and along the river bank beneath low terrace alluvial sediments to Dunnstown. Within the project area, the Tully limestone is overlain by dark gray Devonian marine shales and is underlain by similar shales of the Mahantango Formation. The age of the bedrock in the project area as a whole ranges from Silurian to Devonian. The north side of the West Branch Valley is dominated by marine shales and limestones of Devonian (Tully and Mahantango Formations) and Silurian age (Figure 8), while the Silurian age Tonoloway (limestone) and Wills Creek (shale) Formations crop out

Figure 8.
Idealized Stratigraphic Section in the General Lock Haven Project Area

PERIOD	GROUP/FORMATION	DESCRIPTION
Quaternary*,**	?	Unconsolidated sediments of late Pleistocene and Holocene age. Sediments composed of water-laid (fluvial) and glacio-fluvial materials. Present in the West Branch and Bald Eagle drainage basins.
	UNCONFORMITY	
Pennsylvanian	Pottsville Gp.	Predominately sandstones and conglomerates with thin shales and coal
Mississippian	Mauch Chunk Fm.	Predominately red shales with brown to greenish gray flaggy sandstones
Mississippian	Pocono Gp.	Predominately gray, hard, massive, cross-bedded conglomerate and sand-stone with some shale.
Devonian	Oswayo Fm.	Brownish and greenish gray, fine and medium grained sandstones with red shales and discon-tinuous calcareous lenses
Devonian	Marine beds*	Gray to olive brown shales, graywackes, and sandstones; contains Chemung and Portage beds, Tully limestone at base.
Devonian	Mahantango, Marcel-lus and Onondaga** Fms.	Mahantango: brown to olive gray shale with interbedded sandstone, highly fossilif-erous; Marcellus: black, fissile shale with thick brown sandstone in parts; Onondaga: greenish blue shale and dark blue to black limestone, siliceous in places.

Devonian	Oriskany Fm.**	Oriskany: white to brown, fine to coarse-grained sandstone, occasionally calcareous, conglomeratic and fossiliferous (Ridgeley) at top; dark gray, cherty limestone with some inter-bedded shales and sandstones below (Shriver); Helderberg:
Devonian	Helderberg Fm.**	dark gray calcareous, thin bedded shale at top, thin bedded fossiliferous lime-stone with some local sand-stones in middle; and at the base dark gray medium to thick bedded limestone, sandy to shaly in places with some chert nodules.
Silurian	Keyser Fm.**	dark gray, fossiliferous, thick bedded, crystalline to nodular limestone, occasion-ally cherty.
Silurian	Tonoloway Fm.	gray, laminated, thin bedded argillaceous limestone
Silurian	Will Creek Fm.	greenish gray, thin bedded, fissile shale with local limestone and sandstone zones
Silurian	Bloomsburg Fm.	red, thin and thick bedded shale and siltstone with local units of sandstone and thin impure limestone
Silurian	McKenzie Fm.	greenish gray, thin bedded shale interbedded with gray, thin bedded, fossiliferous limestone

*- Major stratigraphic units present in the Phase I study area.
**- Potential chert-bearing units.

along the south side of the valley (see Figures 9 - 11). In general if one were to walk due south from Lockport, older and older rocks would be encountered as one cross cuts the anticlinal structure. The regional inclination of these bedrock units is 20 to 50° to the north. Several joint systems are prominent, one of the most pronounced being a NW-SE trending set oriented ca. perpendicular to the regional structure trend. It is interesting to note that the trend of the West Branch channel as it cross-cuts the Allegheny Front also displays a NW-SE trend. This occurrence would imply some structural control (joint set control) on the river as it cross-cut the regional structural trend.

Figure 12 depicts the surficial geology and age of the rocks within the project area. Overlying these bedrock strata within the West Branch and Bald Eagle Creek valleys is approximately 3 feet (0.9 m) to over 60 feet (18.3 m) of unconsolidated Quaternary age alluvium and colluvium.

Presently, five terrace surfaces can be identified within the general project area. These terraces occur at 0 - 10 feet (T0); 20 - 25 feet (T1); 35 - 40 feet (T2); 80 - 85 feet (T3) and 115 - 125 feet (T4) above the normal pool elevation of the West Branch Channel at the Jay Street Bridge (535.18 feet above mean sea level). It should be noted that to date, all of the historic and prehistoric sites identified in the study area are situated within a thin (less than 6 feet) blanket of Holocene age overbank alluvium that covers the T1 terrace surface in both Lock Haven and Lockport. As stated above this terrace surface lies ca. 20 -

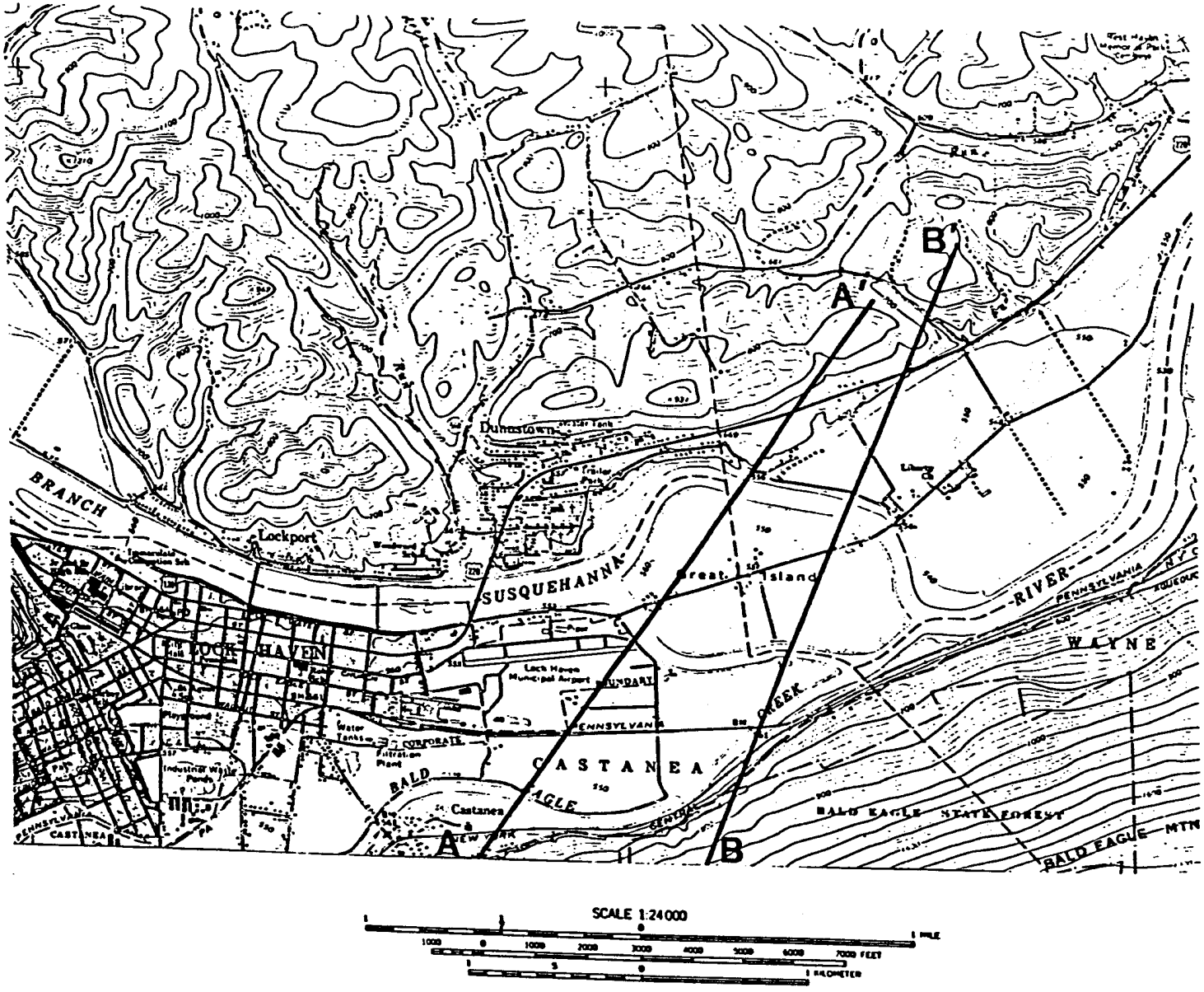


Figure 9. Planview of trend of geologic cross sections displayed in Figures 10 and 11.

Figure 10. N40^{0}E geologic cross section (A - A') of the West Branch and Bald Eagle Creek Valleys.

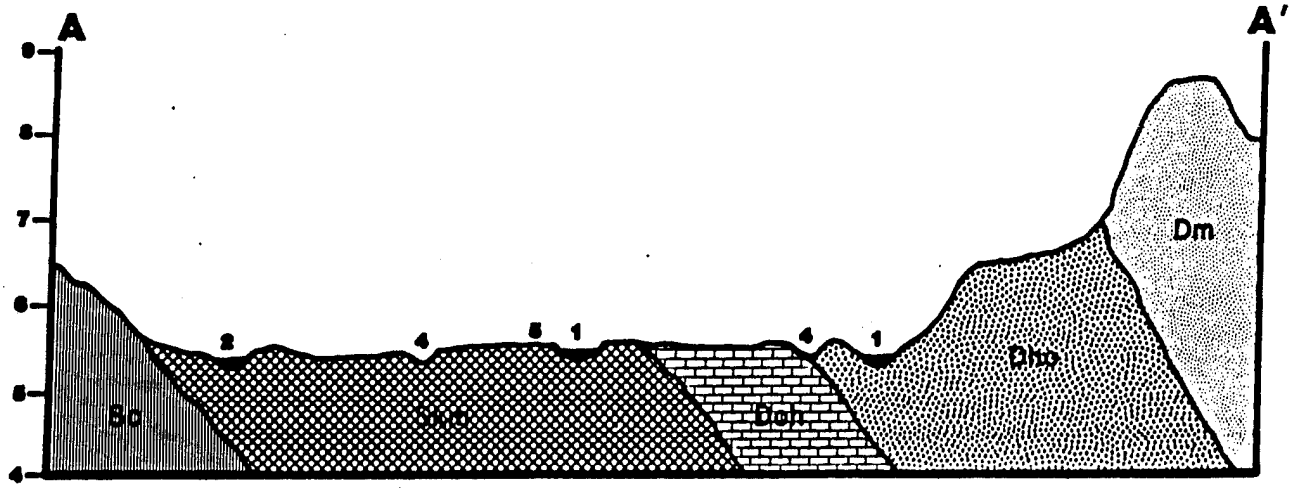
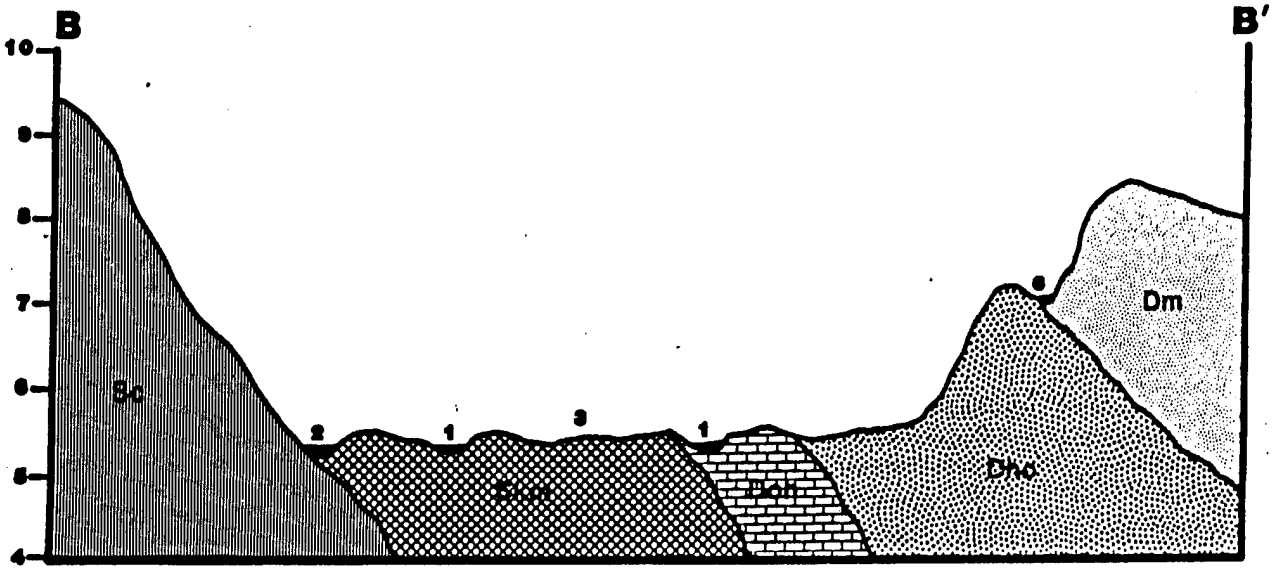


Figure 11. N25^{0}E geologic cross section (B - B') of the West Branch and Bald Eagle Creek Valleys.



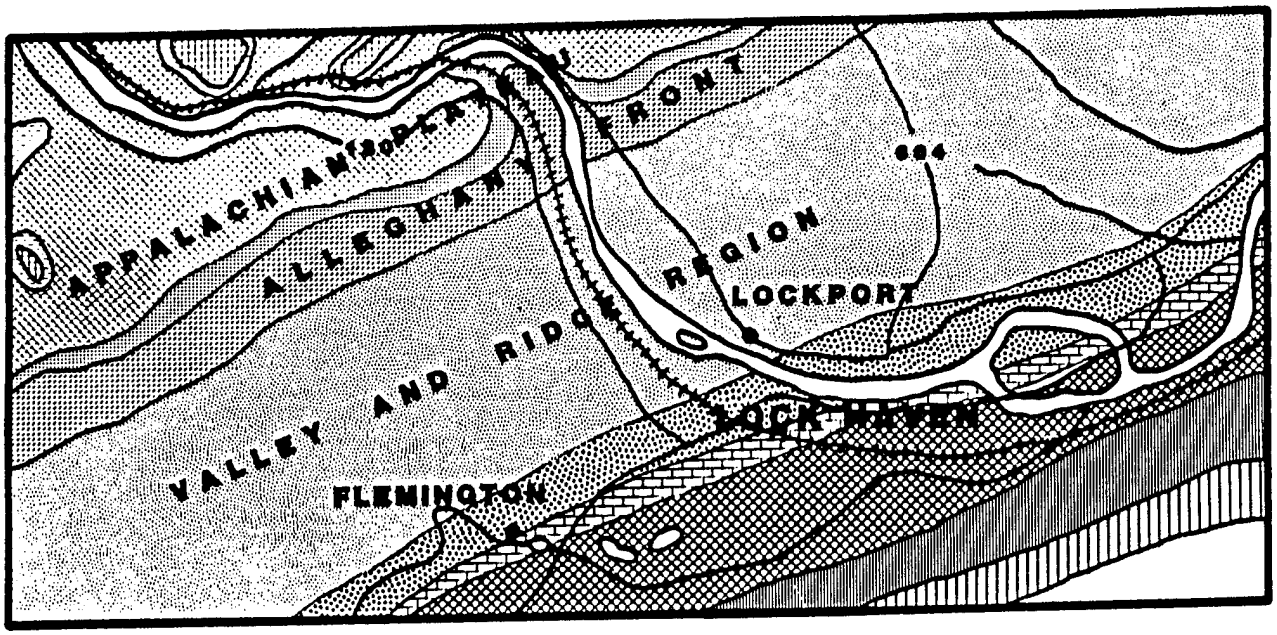
LEGEND

FEATURES

1 West Branch Susquehanna River
2 Bald Eagle Creek
3 Great Island
4 Abandoned Meander Scars
5 East End of Airport Runway
6 Unnamed Tributary

GEOLOGY

Sc
Skm
Doh
Dho
Dm



LEGEND

- Railroad
- Pp Pottsville Group
- Mmc Mauch Chunk Formation
- Mp Pocono Group
- Doo Oswayo Formation
- Dck Catskill Formation
- Dm Marine Beds
- Dho Mahantango, Marcellus, and Onondaga Formations
- Major Routes
- Doh Oriskany and Helderberg Formations
- Skm Keyser, Tonoloway, Wills Creek, Bloomsburg, and McKenzie Formations
- Sc Clinton Group
- St Tuscarora Group
- Oj Juniata Formation

Figure 12. Surficial geology of the general Lock Haven study area.

25 feet (6.1 to 7. 6 meters) above the normal pool elevation of the West Branch or at roughly 555 to 560 feet (169.8 to 171.3 meters) above mean sea level. Under natural flow conditions (not affected by existing dams or reservoirs) this terrace surface would be inundated once every 4 to 7 years. Although other sites are probably present on the higher terrace levels, these areas will not be adversely affected by the flood control project. The absence of any potentially significant cultural resources on the lowermost T0 terrace is not unexpected based on its relative recent geologic age (probably very late Holocene) and the fact that this lower terrace surface is heavily flood scoured during periods of bankfull discharge. The the T1 - T3 terraces are Pleistocene in age while the upper strath terrace (T4) is of early Tertiary or late Cretaceous age.

Hydrology of the Project Area

Surface Water Hydrology

The headwaters of the West Branch of the Susquehanna River are located in central Pennsylvania in Cambria County near Ebensburg and flows north for approximately 30 miles (48 km). It then flows northeast and then south across the Appalachian Plateau to the Allegheny Front just west of Lock Haven. At this point, the river enters a somewhat broad, asymetric fertile valley and flows eastward for ca. 40 miles (64 km). It then flows southward to its confluence with the main stem of the Susquehanna River at Sunbury. The West Branch has an average channel slope or gradient of 10 feet per mile (3.3 m per km) above the Sinnemahoning Creek and about 2.5 feet per mile (0.8 m

per km) below that point to its confluence at Sunbury. The drainage area of the West Branch above the Jay Street Bridge at Lock Haven is 3,337 square miles (5,339.2 square km).

Bald Eagle Creek a major tributary of the West Branch originates in the foothills of the Allegheny Mountains near the southwestern edge of Centre County. It flows northeast for ca. 51 miles (81.6 km) to its confluence with the West Branch just east of Lock Haven. The drainage area above its confluence with the West Branch is 770 square miles (1232 square km) (Phase I Design Memorandum 1980).

Presently there are four flood control projects or reservoirs affecting the flows of the West Branch and Bald Eagle Creek. These include: 1) the George B. Stevenson Dam on the First Fork of the Sinnemahoning River; 2) the Alvin R. Bush Dam on Kettle Creek; 3) the Curwensville Dam on the West Branch and 4) the Foster Joseph Sayers Dam on Bald Eagle Creek (Phase I Design Memorandum 1980).

Streamflow Data

Continuous streamflow records of river stages and discharges on the West Branch of the Susquehanna River have been maintained since 1928. Based upon soil water budget calculations developed for this study, it is clear that most of the annual precipitation and associated surface runoff and flooding occurs from March through May, while the lowest flows occur during the period June through October, with September and October being on average the dryest and lowest flow months. During these low flow periods the West Branch and Bald Eagle Creek are primarily supplied by base flow (groundwater recharge). Based upon available paleoclimatic

data it would appear that similar climatic conditions as those which occur today would have prevailed during the late Holocene (Knox 1983, Vento and Fitzgibbons 1986). At present to little data is available to make more than qualitative statements concerning stream flow, flooding, terrace development and climate change for earlier periods of the Holocene.

Streamflow Characteristics

There are two controls of flooding in the Lock Haven area proper: 1) peak discharge (flood stage) on the West Branch of the Susquehanna River and 2) peaks flows on Bald Eagle Creek. In most cases flooding along Bald Eagle Creek occurs due to downstream base-level control by the West Branch. As a result of the backflooding from the West Branch and coincidental flows on Bald Eagle Creek, peak flood stages along Bald Eagle Creek usually occur at the same time as floods on the West Branch.

Coincident flows on Bald Eagle Creek can and have in the past caused minimal increases in flood elevations downstream from its confluence with the West Branch. Table 1 lists estimated flood crest elevations above bankfull stage (21 feet) from 1847-1979 at the National Weather Service gage at the Jay Street Bridge in Lock Haven. The drainage area above the Jay Street Bridge is 3,337 square miles (5,339.2 square kilometers) and the gage height datum at this locality is 535.18 feet (163.77 meters) above mean sea level (Phase I General Design Memorandum 1980). Figures 13 and 14 are flood recurrence graphs which depict the modified and natural flood recurrence estimates for the West Branch and Bald Eagle Creek, while Figure 15 is a rating curve

Table 1. Known stages and discharges above flood stage (21 feet) at the National Weather Service gage at the Jay Street Bridge for the period 1847-1979 (taken from the Phase I General Design Memorandum, Army Corps of Engineers, Baltimore District: 1980).

West Branch Susquehanna River, Lock Haven Pennsylvania, Estimated Flood Crest Elevations Above Bankfull Stage - 1847-1979

Known stages and discharges above flood stage (21 feet) at the National Weather Service gage at the Jay Street Bridge in Lock Haven are tabulated below. Drainage area = 3,337 square miles; Gage datum = 535.18 feet, m.s.l.

Date of Crest	Stage (ft)	Estimated Elevation	Discharge (cfs)	
1847 1/	25.3	560.5	2/	
1865 1/	24.7	559.9	2/	
Feb 7, 1878	22.0	557.2	98,000	
Jun 1, 1889	29.8	565.0	192,000	
May 1894	26.4	561.6	141,000	
Mar 1, 1902	23.7	558.9	113,000	
Mar 4, 1904	24.2	559.4	117,000	
Mar 14, 1907	24.5	559.7	120,000	
Feb 21, 1918	26.8	562.0	146,000	
Mar 4, 1923	25.1	560.3	126,000	
Mar 18, 1936	32.3	567.5	238,000	
Apr 1, 1940	21.7	556.9	95,000	
Dec 31, 1942	23.2	558.4	108,000	
May 28, 1946	26.9	562.1	147,000	
Nov 26, 1950	27.6	562.8	157,000	
Jan 26, 1961	21.1	556.3	90,000	3/
Mar 10, 1964	26.1	561.3	138,000	4/
Jun 23, 1972	31.3	566.5	190,000	5/
Sep 26, 1975	22.9	558.1	91,500	5/

1/ From "Lock Haven Express", March 17, 1964
2/ Not determined.
3/ Upstream control by George B. Stevenson Reservoir.
4/ Upstream control by Stevenson and Alvin R. Bush Reservoirs.
5/ Upstream control by Stevenson, Bush, and Curwensville Reservoirs.

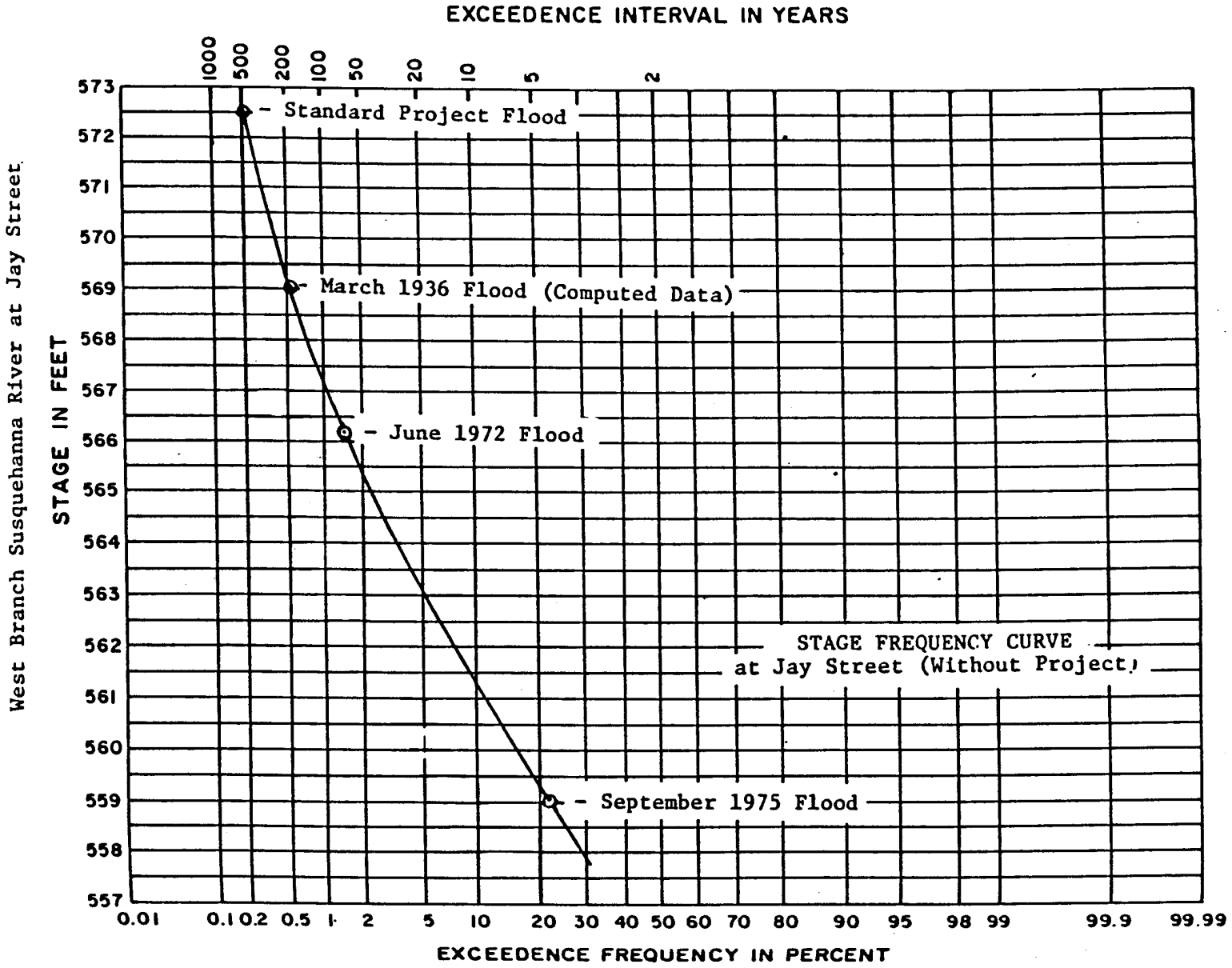


Figure 13. Flood recurrence graph for the West Branch of the Susquehanna River at the Jay Street Bridge (taken from the Phase I General Design Memorandum, Army Corps of Engineers, Baltimore District: 1980).

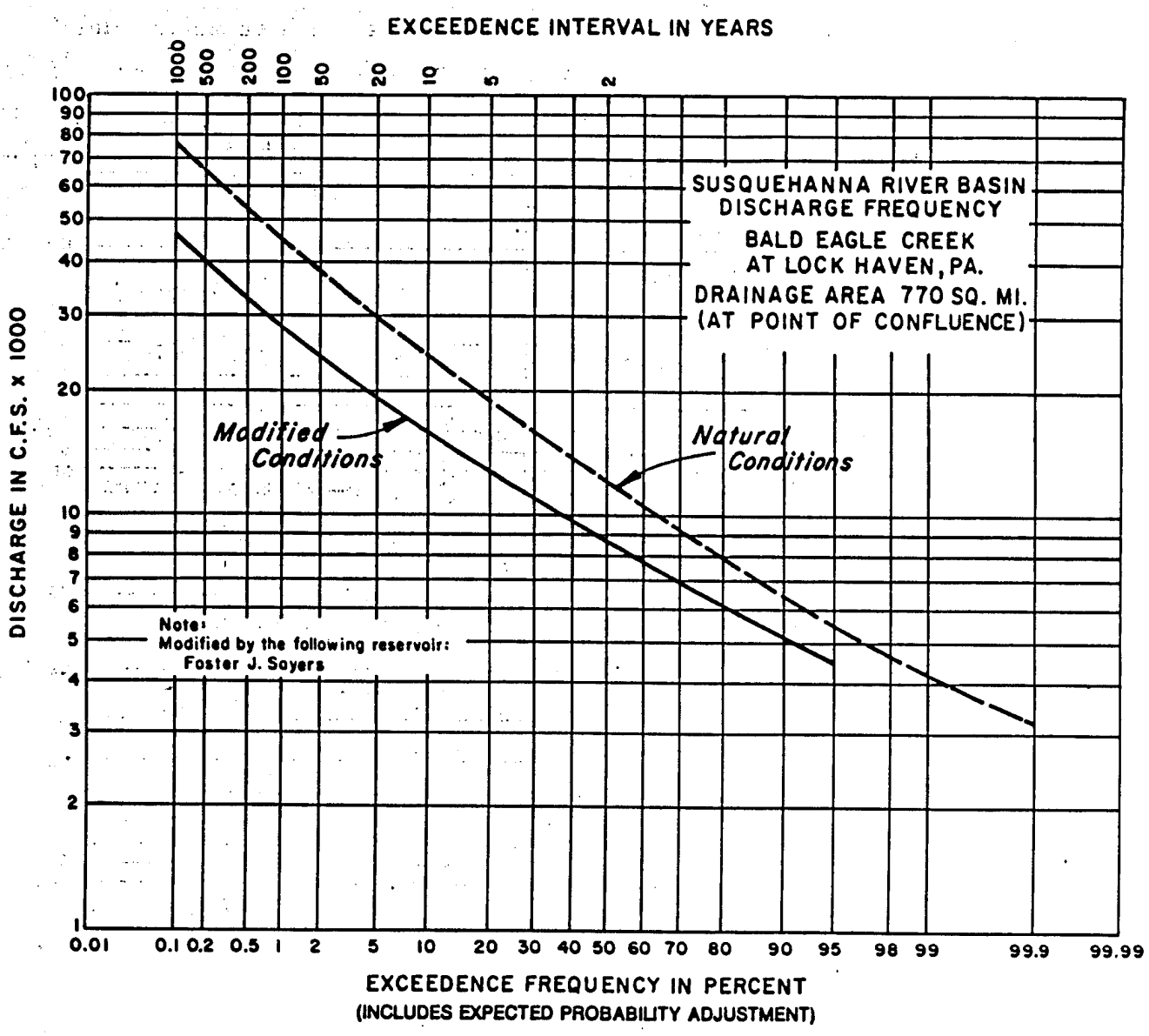


Figure 14. Flood recurrence graph for Bald Eagle Creek at Lock Haven (taken from the Phase I General Design Memorandum, Army Corps of Engineers, Baltimore District: 1980).

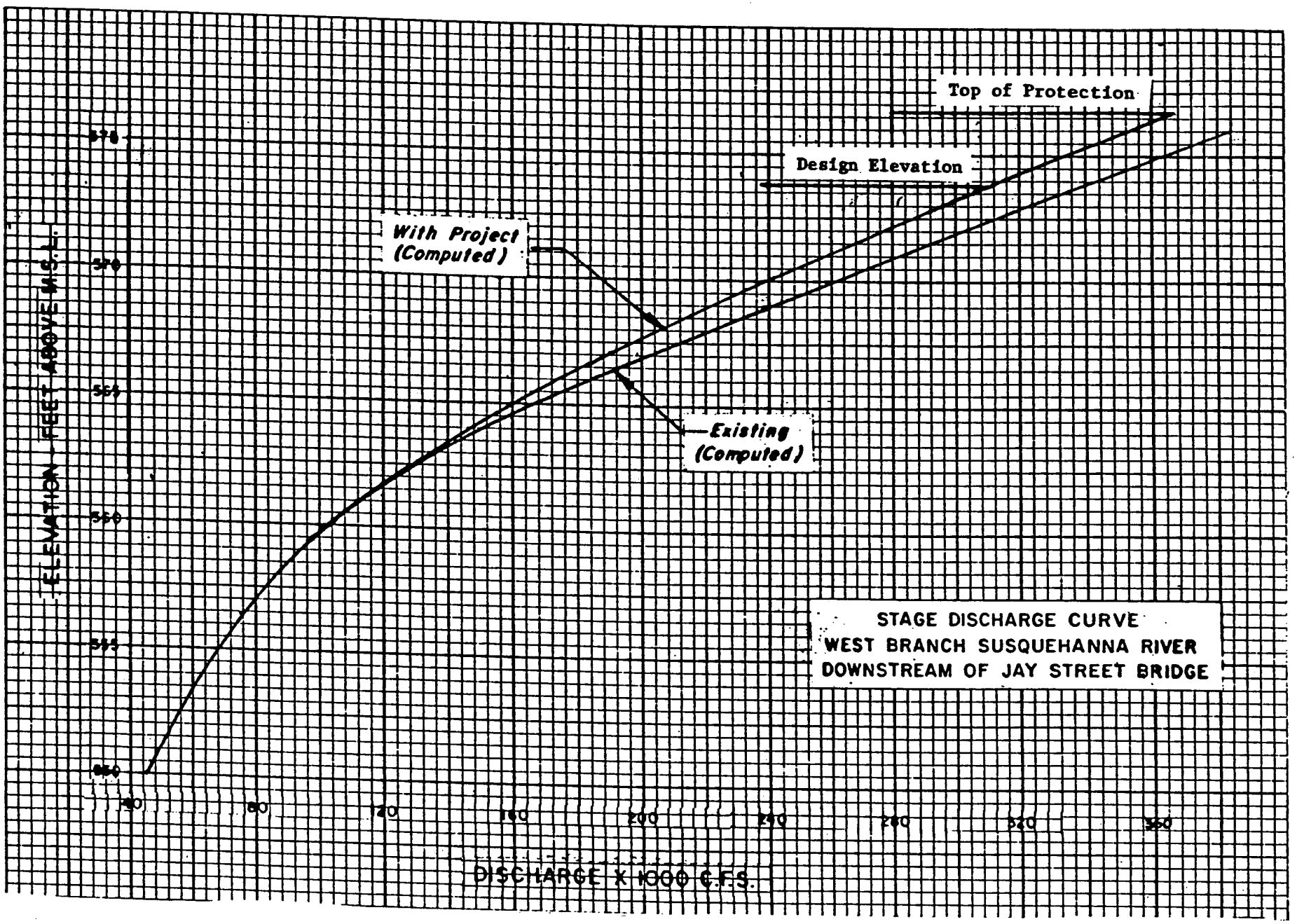


Figure 15. Rating curve for the West Branch of the Susquehanna River at Lock Haven (taken from the Phase I General Design Memorandum, Army Corps of Engineers, Baltimore District: 1980).

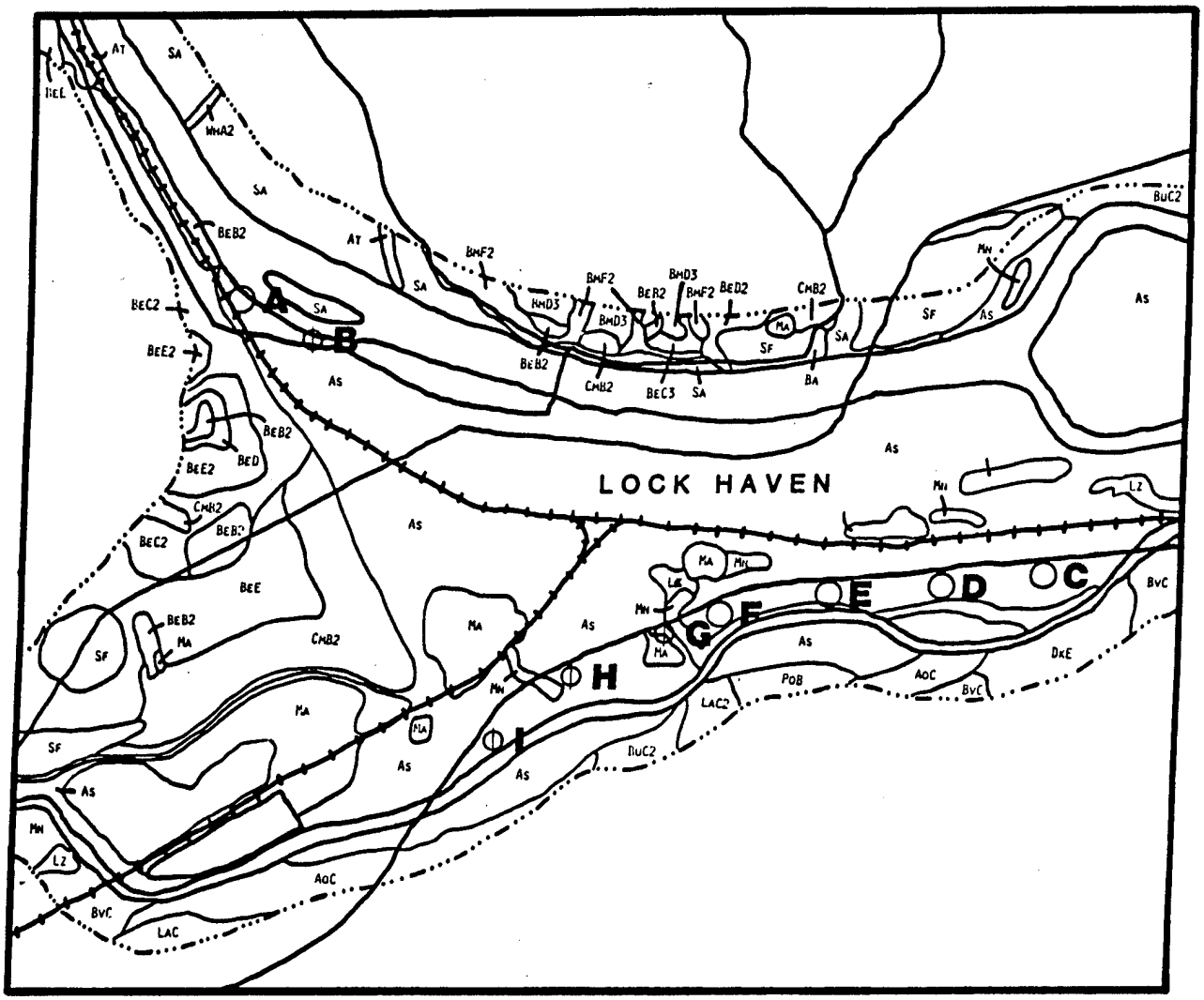
for the West Branch just downstream from the Jay Street Bridge.

Soils

The soils in the general study area are formed from unconsolidated water-laid fluvial and glacio-fluvial materials. In general, the soils southeast of the Allegheny Front (outside the major drainage lines) have primarily formed from carbonate and non-carbonate rocks of Pennsylvanaian through Ordovician age. The underlying lithologies are sandstones, shales, conglomerates, dolomites and impure limestones. The soils range in thickness from 30 to 70 inches (76.2 to 177.8 cm) and slopes range from 3 to 40 %.

Within the study area proper, two soil associations are present. These include the Hazelton-Berks-Watson association which are soils which have developed in glacial deposits and the Duncannon-Barbour-Pope assocations which are soils that have formed in unconsolidated water-sorted materials. The West Branch channel essentially demarks the boundary line between these two soil associations, with the Hazelton-Berks-Watson association soils present to the north of the West Branch channel and the Duncannon-Barbour-Pope association soils lying to the south of the West Branch channel.

At present all of the prehistoric sites identified along the construction corridor proper are situated within or on the Ashton silt loam (Entisol; Aeric Fluvaquent) soil series (Figure 16). This well-drained soil series is restricted to the T0 and T1 terraces within the project area. Based upon Hay's (1979, 1980) earlier investigations and those of Vendel Enviro-Industrial Consultants, Inc. (Sub-Contractor present study) it appears that



LEGEND

Railroads

Major Routes

Area of Study

A Surface Survey Sites

B Shovel Test Transect Sites

N

Key To Soils And Archeological Sites On Following Page

Figure 16. Soils and Archaeological site location. Note that every site recorded to date is located on both the well-drained Ashton silt loam soil and the T1 terrace surface.

Table 2. Soil series which occur within the general project study area and the location of previously recorded archaeological sites. Note that all prehistoric sites identified to date occur on the Ashton silt loam soil series.

SOILS	AoC	ANDOVER VERY STONEY LOAM, 8 - 25% SLOPES
	As	ASHTON SILT LOAM
	At	ATKINS SILT LOAM
	Ba	BARBOUR FINE SANDY LOAM
	BeB2	BERKS CHANNERY SILT LOAM, 3 - 8% SLOPES
	BeC2	BERKS CHANNERY SILT LOAM, 8 - 15% SLOPES
	BeD	BERKS CHANNERY SILT LOAM, 15 - 25% SLOPES
	BeE	BERKS CHANNERY SILT LOAM, 25 - 35% SLOPES
	BeD2	BERKS CHANNERY SILT LOAM, 5 - 25% SLOPES, MODERATELY ERODED
	BeE2	BERKS CHANNERY SILT LOAM, 25 - 35% SLOPES, MODERATELY ERODED
	BeC3	BERKS CHANNERY SILT LOAM, 8 - 15% SLOPES, SEVERLY ERODED
	BmD3	BERKS-MONTEVALLO CHANNERY SILT LOAM, 15 - 35% SLOPES, SEVERLY ERODED
	BmF2	BERKS-MONTEVALLO CHANNERY SILT LOAM, 35 - 100% SLOPES, MODERATELY ERODED
	BuC2	BUCHANAN GRAVELLY LOAM, 8 - 15% SLOPES, MODERATELY ERODED
	BvC	BUCHANAN VERY STONEY LOAM, 8 - 25% SLOPES
	CmB2	COMLY SILT LOAM, 3 - 8% SLOPES, MODERATELY ERODED
	CmC2	COMLY SILT LOAM, 8 - 15% SLOPES, MODERATELY ERODED
	DkE	DEKALB VERY STONEY SOILS, 25 - 100% SLOPES
	LaC	LAIDIG VERY STONEY LOAM, 8 - 25% SLOPES
	LaC2	LAIDIG GRAVELLY LOAM, 8 - 15% SLOPES, MODERATELY ERODED
	Lz	LINDSIDE SILT LOAM
	Ma	MADE LAND
	Mn	MELVIN AND NEWARK SILT LOAMS
	PoB	POPE LOAMS, FANS, 3 - 8% SLOPES
	Sa	SEQUATCHIE LOAM
	Sf	SEQUATCHIE FINE SANDY LOAM (HIGH)
	WhA2	WHITEWELL SILT LOAM, 0 - 5% SLOPES, MODERATELY ERODED
SITES	A	ISLAND VIEW, CN 166
	B	WATER STREET 2, CN 170
	C	CRISSMANS 2, CN 167
	D	CRISSMANS 3, CN 168
	E	CRISSMANS 4, CN 171
	F	CRISSMANS 5, CN 172
	G	CUMMINGS 3, CN 173
	H	CUMMINGS 2, CN 169
	I	CUMMINGS 4, CN 174
	J	CUMMINGS 5, CN 177

a buried, cultural-bearing paleosol is frequently found as an horizon within the Ashton soil series on or within the T1 terrace sequence. It is felt by this investigator that the pedogenic development of paleosols on low terrace alluvial contexts within the Susquehanna River drainage basin documents past episodes of fluvial stabilty and non-deposition on the flood plain during periods of probable cooler-moister climatic conditions. Holocene and possible Pleistocene hiatuses in overbank discharge would have allowed for relatively long-term (several hundred years) aboriginal utilization of these terrace surfaces and subsequent A-horizon development. In general, when present (and not exhumed by plowing), these paleosols are stratigraphically sealed above and below by somewhat coarser-grained, culturally sterile, alluvial overbank deposits which were emplaced during periods of renewed fluvial activity.

Climate

The proposed Lock Haven project is located in the upper and central West Branch Susquehanna subbasin of the Susquehanna River basin. Storm tracks frequently cross the area from the north, west and south. Storms from the east are less frequent. Canada and the Central Plains govern the area's humid continental climate. The Gulf of Mexico is one of the primary sources of moisture; the Atlantic Ocean moderates the climate more than provides moisture.

The winters in the general study area are controlled by storms that originate in Canada and travel south from the Hudson Bay or east from the Rocky Mountains. Cold Canadian air, clear

skies, and snow cover may cause sub-zero weather. At times, warm air from the Gulf of Mexico travels north causing alternate thawing and freezing. The Atlantic Ocean has less effect on winter weather than does Canada, but when it controls the weather, storms are severe with high winds, heavy rains, and heavy snows. Winter weather changes every few days and extended periods of extreme cold are rare.

Summer weather systems usually originate from the southwest. Summer storms bring heavy rains or hot, humid weather. Temperatures peak during July. It is during this time that rates of evapotranspiration exceed precipitation and soil water defecits occur. Thunderstorms increase after the winter months, peak in mid-summer, and become less frequent as the colder months begin.

Mean annual precipitation for the area is approximately 40 inches (15.75 cm). Average annual temperatures in the study area range from 45°F to 50°F. Temperatures as high as 105°F have been recorded during August and as low as -31°F in January. Because of the variable topography and relief, the mean annual freeze-free period ranges from 130 days to 165 days.

Preliminary Results of Disturbance Study and Areas Recommended for Phase I Cultural Resource Investigations

Lusk Run Diversion Pipe and Susquehanna Tie-Out

The Lusk Run Diversion Pipe has been deleted from the flood control protection plan, however, the Susquehanna Tie-Out is still included in the Phase II Design Memoradum (1987).

In Lock Haven, from roughly the center of the university soccer field the Lusk Run diversion pipe trends N55°E through university grounds to the curb edge of Route 120. The soils in this area have been extensively disturbed by several university buildings, sidewalks and subsurface utility lines and pipes. At the eastern curb edge of Route 120 the diversion pipe crosses over an undisturbed grassy area between a three story brick and two story white frame building. Several additonal shovel test probes and deep bucket auger tests should be excavated in this area. The Run diversion pipe and associated Susquehanna levee tie-out structure continues across the railroad grade and down the southern cut-bank of the West Branch. The soils in this area have been extensively modified by the construction of the railroad grade and the present Lusk Run diversion pipe.

Levee/Flood Wall Corridor

Station 105 to 115

At roughly Station 105 the levee corridor turns east and parallels the south bank of the West Branch. From the point at which the Lusk Run diversion pipe enters the river to Island View Park (Station 107) the area comprising the levee corridor is heavily disturbed. At Island View Park, however, intact alluvial

deposits are present. A small gravel road, however, does crosscut the lower T0 and upper T1 terraces at this locality. The Island View site proper was located by Hay (1986) on this upper T1 terrace.

From the eastern boundary of the Island View site the proposed levee corridor is presently covered with an asphalt parking lot. Although this area has received some disturbance during construction of the parking lot, in situ cultural-bearing deposits may be present under this artificial asphalt blanket. This statement is supported by the following: 1) Hay (1986) recovered prehistoric artifacts at the Island View site to a depth of 1.35 m and 2) During construction of the university parking lot, artifactual materials were collected and several reputed burials were exhumed.

From the western edge of the university parking lot the levee corridor continues to parallel the West Branch channel. In this area the proposed construction will adversely impact a conveninece store, a pizza shop and a dentist's office. Although the soil(s) in the immediate vicinity of these structures have been extensively disturbed, there is a series of small, undisturbed grassy areas that exist behind each of these structures. Additonal Phase I investigations should be conducted under the university parking lot (when appropriate) as well as behind the above businesses.

Station 128 to 131

From the eastern edge of the dentist's office (at a small municipal park) to the western boundary line of the Piper home

(at the eastern edge of the municipal park) a narrow, undisturbed segment of alluvial soils is present. Hay (1986) identified the occurrence of a single prehistoric designated Water Street Site II along this segment of the levee corridor. This site is located at the extreme western edge of the municipal park along Water Street. Not surprisingly, this site occurs on the only undisturbed parcel of land (Hay 1986) in the park wide enough to conduct Phase I testing. In the immediate vicinity of the Piper home (based solely upon visual inspection) it appears that only several small areas of undisturbed land is present. Limited Phase I testing should be conducted in both the narrow front and back yards of the Piper home on Water Street.

Station 128 to 161

Just east of the Piper home the proposed levee corridor is situated in the immediate vicinity of the Immaculate Conception Catholic School. In this area the alluvial soils have been extensively disturbed by the earlier Queens Run Brick Factory and presently the Immaculate Conception School itself. Topograhically, this area is slightly (ca. 1 to 2 meters) higher than the surrounding T1 terrace surface. This noticeable topographic rise is probably attributable to "fill" associated with the Queens Run Brick Factory.

From the eastern edge of the Immaculate Conception School property boundary line to roughly 20 meters (60 feet) east of Mill Street the levee corridor will impact both undisturbed alluvial deposits (both lateral and vertical acrretionary deposits) as well as a number of mid- to late 19th century saw

mill sites and potential historic structures associated with these mills. It should be stressed that there is a high probability that both in situ prehistoric and historic sites will be encountered during the next phase of testing (when appropriate). Although only very limited testing was conducted along this reach of corridor, Hay (1979; 1986) did identify the presence of a prehistoric archaeological site designated Water Street site I. This site is located roughly between the foot of 1st and 2nd Street along Water Street in Lock Haven. From a point (Station 149) ca. 20 m (60 feet) east of Mill Street at the edge of a small grassy area to the western edge of the Jay Street Bridge the alluvial soils have been substantially disturbed by a number of large buildings, utility lines and road/bridge construction. Along this reach of the levee corridor the following areas should be examined: 1) the backyards of the Grafius and Mackey houses and 2) the grassy area at the Green. There is a high probability that the intact alluvial soils in this area will contain both historic and prehistoric archaeological materials.

Station 161 to 226

From the eastern edge of the Jay Street Bridge to the western boundary of Memorial Park, no further archaeological work need be conducted aside from the extant Bald Eagle Creek Cross-Cut Canal Lock. Along this segment of the levee corridor, construction will primarily impact the river channel and the flood scoured scarp slope of the river bank. The soils in this area have been extensively flood scoured and disturbed by

construction of Water Street as well as the fact that the area available for testing is too narrow as to permit any additional Phase I testing. It should be noted that if construction does impact the southern side of Water Street or the road base itself, additional Phase I testing should be conducted to locate both Fort Reed, the Indian burial mound or any other cultural resources that may exist under road level or on the south-side of Water Street.

Station 226 to 258

From Memorial Park (and the Memorial Park site) to the eastern and southern edge of the Municipal Airport the levee corridor skirts around the western edge of an "old" municipal dump and proceeds across the airport runway area to the northern edge of the Airport Trenches (American Color Chemical dump site) "old" municipal dump. In this the area the soils are undisturbed, aside from previous agricultural activities and slight grading during construction of the airport runways.

From the southern edge of the municipal dump, the levee corridor once again crosses undisturbed alluvial soils. During the recent Phase I testing conducted by Vendel, Inc., no potentially significant archaeological sites were encountered at the airport or in the lands tested to the south of the American Color Chemical dump site and to the north of the railroad grade.

Station 258 to 266

In this segment of the flood control project, the levee corridor crosses the railroad grade in a southerly direction and

then turns abruptly due east where it passes between U.S. 220 and the railroad grade. The levee then passes under the U.S. 220 bridge over the Township Road (T-375) into the Bald Eagle Creek drainage basin. Along this entire segment of the levee corridor the soils have been extensively modified and disturbed (to a depth of ca. 10 feet) by construction of the railroad grade, U.S. 220 and Township Road 375.

Station 266 to 360

For the entire length of the bypass through Castanea Township, between Township Road 375 on the east and the Castanea Bridge over Bald Eagle Creek immediately south of the Hammermill Paper Company Plant, a levee is placed on the creek side (south side) of the existing roadway embankment in a piggy-back manner. A short segment of wall connects the levee to the east side of the U.S. 220 bridge over Bald Eagle Creek (Station 360).

Based upon Hay's (1986) investigations and Vendel's recent disturbance study it is clear that the soils located just to the south of the toe of the U.S. 220 embankment are undisturbed. For the most part the artificial drainage line at the toe of the U.S. 220 embankment can be used as a dividing line between soils which have received prior disturbance (to the north of the drainage ditch) and soils which are undisturbed (aside from agricultural disking and plowing) to the south of the drainage line. Crissmans sites II-V are located along this reach of the levee construction corridor.

At Station 320 or rather at a point ca. 150 meters (495 feet) east of Hanna Street along the U.S. 220 embankment, the

levee corridor curves southwest toward the back of the Castanea firehouse. In this ca. 150 meter (495 feet) long corridor the soils have been extensively disturbed by grading and dumping. Presently, this area is covered with gravel and serves as a location for the parking of heavy equipment.

On the western side of Hanna Street, between Hanna Street and the Jay Street Connector, both undisturbed and disturbed soils were encountered. The disturbed soils were restricted to an area just east of the Jay Street Connector for 90 meters (297 feet) and at an elevation of 166.7 meters (545 feet) above mean sea level and below. The remaining segment of the levee corridor between Hanna Street and the Jay Street Connector is situated on undisturbed alluvial soils (location of Cummings site III).

To the west of the Jay Street Connector in an area which Hay (1986) was denied access, the soils are extremely poorly drained with only a small area of well-drained undisturbed ground present. Whether these present poor drainage conditions are natural or are a result of the construction of U.S. 220 is presently unknown. Phase I testing in this area were negative for the recovery of any historical or prehistoric cultural resources. No further, testing is warranted in this area.

Just west of the "access denied area" (at Station 345), the soils are undisturbed (this is the location of Cummings Site II). At the western edge of Cummings site II, Hay (1986) encountered a toxic waste area, although testing was conducted in the western portion of this toxic area, no archaeological materials were recovered. Hay (1986), however, did locate two additional archaeological sites (Cummings sites IV and V) on undisturbed

soils to the west of the toxic waste area. It should be stressed here, that before any further archaeological work is conducted at Cummings sites II - V, site specific soil tests (for heavy metals and chemicals) be conducted. The migration of leachate from toxic areas via ground water and surface water scouring to what appears to be non-toxic lands should be considered prior to any further archaeological work along Bald Eagle Creek.

Station 360 to 372

At Station 360, the levee shifts to the northern side of the U.S. 220 embankment to the eastern edge of the Hammermill Aeration Pond (Station 372), the levee corrdior will primarily rest on the creek bank. In this area the soils appear to be relatively undisturbed, and hence, there is a high probability for the occurrence of prehistoric archaeological site(s).

Station 372 to 388

From the eastern to western edge of the Hammermill Aeration Pond, the levee corridor is situated on the ponds southern rip-rap wall and on the low creek bank. Although most of the alluvial soils along this reach of Bald Eagle Creek appear undisturbed, there is a low probability for the occurrence of archaeological sites. The reason being that this area is flood scoured at least once a year and that the soils are of recent age.

Station 388 to 395

From the western edge of the Hammermill Aeration Pond the levee corridor leaves the creek bank and curves northwesterly on

a overland route. For ca. 200 meters (600 feet), from the western side of the waste water treatment tank to where the levee crosses under a pair of high power tension wires, the levee corridor crosses essentially undisturbed alluvial soils. In places, however, there is up to 1 meter of fill overlying undisturbed alluvial deposits. Additional Phase I testing should be conducted along this reach of levee corridor.

Station 395 to 415

From an unamed gravel road and the aforementioned high power tension wires the levee continues overland in a northwesterly direction toward the Hammermill railroad yard/tracks. In this area the levee corridor crosses extremely disturbed/artifical ground. As the levee encounters the railroad tracks, it turns to the southwest and parallels the railroad grade (to the north) and rests on "old" Hammermill landfill to the south.

Station 415 to 444

At roughly Station 415 the levee corridor crosses the railroad grade and continues in a southwesterly direction to approximately Station 425, where it once again follows the trend of Bald Eagle Creek. From Station 425 to the southern edge of the Pennsylvania Canal (Station 444), the levee corridor essentially follows an artificially raised gravel and ash road built on landfill. In sum, from the high power lines and unimproved gravel road to the southern edge of the Pennsylvania Canal the levee corridor will only impact disturbed and/or artificial ground.

Station 445 to End of Flemington Tie-Out

From the northern edge of the Pennsylvania Canal to where the levee ties out in Flemington the levee corridor once again impacts undisturbed alluvial soils. Hay's (1986) Phase I testing in this area was negative for the occurrence of any archaeological materials.

Castanea Pumping Station and Discharge Pipe

In Castanea Township, east of Hanna Street and south of the Conrail tracks, a proposed pumping station and discharge pipe are planned in the vicinity of the city sewage treatment plant. The discharge pipe will parallel an existing sanitary pipe to Hanna Street, and then on the west side of Hanna Steet extending to Bald Eagle Creek for a total distance of approximately 600 meters (1800 feet).

Based upon the negative results of Vendel Inc. Phase I testing along a portion of the discharge pipe and pumping station area, it is concluded here that the soils in this area are significantly disturbed and covered with landfill.

Upper Lockport, Lower Lockport, Dunnstown, Watertown and Related Areas

A total of 178 homes (including houses and trailers) along the north shore of the West Branch will be adversely affected by the proposed Lock Haven Flood Control Project. Since no actual levee or flood wall construction will occur along the north shore of the West Branch, the degree of disturbance in terms of both historic and prehistoric cultural resources should be substantially less than that in the greater Lock Haven study

area. In general, the methods used to level or remove a particular structure will dictate the degree of disturbance and hence the type and kinds of archaeological investigations needed.

In relation to areas which are presently disturbed, Lower Lockport exhibits the greatest degree of disturbance. The major cause of disturbance to the natural alluvial deposits in Lower Lockport are the 24 extant structures which comprise the Lower Lockport Historic District. These structures are located ca. 6 meters (18 feet) above the normal pool elevation of the West Branch on a relatively narrow T1 terrace. The depth of alluvium and/or historic fill ranges from 1 meter (just east of the Jay Street Bridge) to probably over 3 or 4 meters (10 or 12 feet) in and around the Lower Lockport homes.

Additionally, no further testing is recommended in the area from the Jay Street Bridge to just west of the first home in the Lower Lockport Historic District. The reasons being that the homes which once stood in this area have been demolished, the basements filled and the area regraded.

Based upon the results of this study and discussions with older residents of the study area, it appears that the lower T0 terrace which extends from the Jay Street Bridge to just west of the Pennsylvania Canal Lock in Lower Lockport is of recent age. No further archaeological testing should be conducted in this area, aside from the extant lock and associated toe path and shute. In this area more extensive testing should be conducted on the river side of road L.R. 18011 on the upper T1 terrace and in the back and side yards of the homes in Lower Lockport.

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